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AUTHOR Enz, Judith; And Others
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ABSTRACT

One hundred eighty studies of science inservice projects reported in the literature from 1973-1980 were reviewed. Sixteen of these studies contained sufficient data for meta-analysis (technique by which treatment effects can be quantified, standardized, and compared using a "size effect" statistic). The magnitude of the effect of the science inservice on teachers and/or their students was considered for this particular analysis. A total of 59 effect sizes was obtained from the 16 studies and grouped into subsets of teacher knowledge, teacher attitude, students knowledge, student attitude, implementation-use of National Science Foundation (NSF) curricula, and preferred type of inservice programs for further analyses. The overall average effect size for science inservice projects, regardless of emphasis, was + .84. The results suggest that science inservice projects have had considerable effect on teachers and/or their students. (Author/DC)

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REVIEW AND ANALYSIS OF REPORTS OF SCIENCE INSERVICE PROJECTS: RECOMMENDATIONS FOR THE FUTURE

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Judith Enz

Willis J. Horak

Milo K. Blecha

University of Arizona

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Abstract

One hundred eighty studies of science inservice projects reported in the literature from 1973-1980 were reviewed. Sixteen of those studies contained sufficient data for meta-analysis. The magnitude of the effect of the science inservice on teachers and/or their students was considered. The overall average effect size for science inservice projects, regardless of emphasis, was + .84. The results suggest that science inservice projects have had considerable effect on teachers and/or their students. Further recommendations are made for future science inservice research.

A Meta-Analysis of the Effects of Science Education Inservice Projects

Over the years hundreds of reports of science inservice projects have appeared in the literature. No review was found to have been done since 1973 when Helgeson, Howe and White compiled Science Education: Abstracts and Index From Research in Education, 1966-1972. This study searched ERIC for science inservice projects reported from 1973-1980. One hundred eighty projects were discovered. Of those, only 27 reported any data, and only 16 of the 27 contained sufficient data for a meta-analysis.

Glass (1978) proposed a technique for a meta-analysis by which treatment effects could be quantified, standardized and compared using the "effect size" statistic (E.S.):

$$E.S. = \frac{\bar{X}_t - \bar{X}_c}{SD_c}$$

where: $\bar{X}_t$ = mean of Treatment Group,

$\bar{X}_c$ = mean of Control Group, and

SD_c = Standard Deviation of Control Group.

E.S. is a standardized measure of treatment effect that may be applied to a single study of averaged across several studies of similar type to provide a composite figure. Notably absent in Glass' technique

is the concept of a statistical test for significance of E.S. All effect sizes regardless of magnitude are worthy in their own right. In this way, the detection of small but consistent treatment effects is made possible across studies.

Method

Initially, 180 studies published from 1973 to 1980 were considered for analysis in this study. Seven studies were unobtainable, 146 studies contained no data and 11 studies contained insufficient data for meta-analysis. In each of the 16 studies analyzed, the magnitude of the effect of the science inservice on teachers and/or their students was considered.

A few studies contained more than one treatment group or contained multiple experimental situations and, therefore, yielded more than one E.S. A total of 59 effect sizes were obtainable from the 16 studies. These were grouped into subsets of teacher knowledge, teacher attitude, students knowledge, student attitude, implementation-use of National Science Foundation (NSF) curricula and preferred type of inservice programs for further analyses.

The 16 studies yielded 21 E.S.'s for teacher knowledge, 12 E.S.'s for teacher attitude, eight E.S.'s for student knowledge, 11 E.S.'s for student attitude, three E.S.'s for implementation-use of NSF curricula and four E.S.'s for preferred type of inservice programs. Only two studies yielded the E.S.'s for implementation-use of NSF curricula and

only one study yielded the E.S.'s for preferred type of inservice programs.

In addition, the subsets of teacher attitudes, teacher knowledge, student attitudes and student knowledge were examined for inservice length, number of participants, level of participants (elementary or secondary). No conclusions could be made in the areas of student knowledge and student attitudes.

Results

The overall average E.S. for science inservice projects, regardless of emphasis, was + .84. This suggests that science inservice projects have had an effect on teachers and/or their students. Table 1 shows the studies and the E.S.'s that contained a teacher knowledge component. The overall average E.S. for teacher knowledge was + .87, which also indicates that teachers made knowledge gains as a result of science inservice projects. No consistent trends were noted regarding length of inservice, number of participants or level of participants.

Insert Table 1 about here

Table 2 shows the E.S.'s for studies containing a teacher attitude component. The overall average E.S. for teacher attitude was + .80, indicating that science inservice projects have been effective in changing teacher attitudes about science. In this area also, no consistent

trends were observable regarding the E.S.'s for length of inservice, number of participants, or level of participants.

Insert Table 2 about here

Table 3 shows the E.S.'s for student attitude and knowledge. The average E.S. for student attitude was + .84, and the average E.S. for student knowledge gain was + 1.30. Both average E.S.'s indicate that students of teachers who participated in science inservice projects made knowledge gains and changes in attitudes toward science.

Insert Table 3 about here

Table 4 shows the E.S.'s for implementation-use of NSF curricula and for preferred type of inservice. The average E.S. for implementation-use of NSF curricula was + 1.64 which indicates that science inservice projects about NSF curricula do cause teachers to use the NSF curricula more. The average E.S. for preferred type of inservice programs was - .50, which indicates that for that one study the participants would have preferred changes in the way inservices were conducted with respect to the areas of content, support, organization and instruction.

Insert Table 4 about here

Discussion

Based on an analysis of the data, the following recommendations are made:

1) Future studies should be conducted to determine the long-term effects of science inservice projects.

2) Future science inservice projects should collect and report sufficient data for evaluation. The majority of the studies reviewed contained insufficient data for evaluation.

3) Future science inservice projects should collect sufficient data to allow analysis of trends regarding the length of the inservice for optimum effect, the number of participants for optimum effect, and the amount of follow-up required for optimum effect.

Conclusion

The average effect size for science inservice projects shows a consistent positive effect of teacher participants and/or their students. The findings indicate a consistent positive effect regardless of the specific science content, or whether the emphasis was on attitude changes or knowledge gains or both. Although the positive E.S.'s were expected since it is almost impossible to get a negative effect with inservice training, the magnitudes of the E.S.'s are considerable.

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Table 1

Effect Sizes for Studies Containing a Teacher Knowledge Component

Study	Inservice Length	No. Part.	Level	Effect Size
160 343	2 full days	A = 27	K-12	A with B + .39
		B = 40		C with B - .36
	(Control = B)	C = 21		D with B - .20
		D = 27		
138 546	6 weeks	29	7-8	+ 1.21
132 027	Varied (survey of	413	K-6	SAPA + .80
	different inservices)	SAPA = 44		ESS + .61
		ESS = 99		ISCS + .69
		ISCS = 118		SCIS + .68
		SCIS = 21		ES + .64
		ES = 131		
114 286	Unknown - college	66	5-12	Earth Sci. + .73
	classes			Phy. Sci. + 2.33
				Biology + .41
				Chemistry + 1.10
				Und. Sci. + .12
100 706	Summer - college	36	8-12	+ 4.04
EJ 128 226	12 50 minute	171	8-12	Biology + .43
	lectures	Bio. = 30		Chemistry + .91
		Chem.= 41		Phy. Sci. + 1.24
		P.Sc.= 58		Physics + .40
		Phys.= 42		Total + .72
EJ 121 536	All day for 5 days. Follow-up. Some 2-year participants.	32	K-6	+ 1.41

Table 2

Effect Sizes for Studies Containing a Teacher Attitude Component

Study	Inservice Length	No. Part.	Level	Effect Size	
139 623	3 weeks	22	K-6		+ .67
106 125	8 weeks	60	K-6	open #1	+ .79
				closed #1	+ .68
				total #1	+ 1.05
				open #2	+ .64
				closed #2	+ .45
				total #2	+ .75
				open #3	+ .65
				closed #3	+ .45
				total #3	+ .74
EJ 203 716	1 week (32 hours)	97	K-6		+ 1.68
EJ 161 202	10 hours plus 2 hours per day for 10 days.	64	K-6		+ 1.07

Table 3

Effect Sizes for Studies Containing

Student Attitude or Knowledge Component

Study	Inservice Length	No. Part.	Level	Effect Size	
	Student Attitude				
091 200	Unknown (A = SCIS Prev. B = No SCIS Prev. A & B - partic. C = SCIS now D = No SCIS now C & D - non-partic.	1941 students	K-6	SCIS/NON-SCIS A with D B with D A with C B with C	+ .31 + .33 + .63 + .12 + .43
EJ 121 536	All day for 5 days Some 2-year partic. (Groups are students of teacher partic.)	32 teachers	K-6	Group 1 Group 2 Group 3 Group 4 Group 5 (69-71) Group 6 (71-72)	+ 1.13 + 1.22 + 1.60 + 1.67 + 1.39 + .13
	Student Knowledge				
103 281	Summer & academic year	39 teachers	7-8	Sect. 1 Sect. 2 Sect. 3	+ 3.03 + 2.20 + 3.03
EJ 121 536	All day 5 days.	32	K-6	Facts Princ. Conc./Proc. Conc. Proc.	+ .59 + .21 + .45 + .50 + .37

Table 4

Effect Sizes for Studies Containing

Implementation/Use of NSF Curricula or

Preferred Type of Inservice Component

Study	Inservice Length	No. Part.	Level	Effect Size	
Implementation/Use of NSF Curricula					
137 098	Varied (survey of various inservices)	597	varied		+ .31
EJ 222 364	Unknown	116 schools	8-12	SCIP	+ 3.77
				Ins. vs. no inservice	+ .85
Preferred Type of Inservice					
135 639	Varied (survey of various inservices)	62	K-6	content	- .44
				support	- .58
				organiz.	- .52
				instruc.	- .44